REMARKS

This is in response to the Office Action that was mailed on September 16, 2002. The amendment to claim 1 is based upon original claim 7 and upon Examples 2, 3, 5-9, and 13. New claim 15 is based upon Example 2. New claim 16 is based upon Example 12. Minor formal amendments are made to claims herein. No new matter is introduced by this Amendment. With this Amendment, claims 1, 2, 8-10, and 12-16 are in the case.

Claims 1, 2, 5-10, and 12-14 were rejected under 35 U.S.C. §103(a) as being unpatentable over US 6,245,485 B1 (Aoai). The rejection is not applicable to the claims as amended.

The Examiner has taken the position that formulae (a19) and (a20) in the reference met the limitations of formulae (1) and (2) in claim 1, and that formulae (a3) and (a10) meet the limitations of formulae (2d) and (2e) in claim 9. The Examiner has also argued that one of ordinary skill in the art would have been motivated by Aoai to make the polycyclic resin (B) of the reference with a hydroxyl group substituent in order to form a composition suitable for exposure using a light source of 220 nm or less and having high sensitivity, good resolution, and high resistance against dry etching.

Aoai discloses a positive resist composition that is exposable using far ultraviolet radiation having a wavelength of 220 nm or less. The compositions comprises (A) a compound that generates an acid on irradiation with an active light ray or radiation, (B) a resin having a polycyclic alicyclic group and a carboxyl group, said resin being either (1) a resin having at least one repeating unit with a polycyclic alicyclic group on a side chain, represented by the formulas XXII, XXIII, or XXIV, or (2) a resin containing at least one repeating unit having an alicyclic group on the main chain, represented by the formulas II or III, and (C) a compound represented by the formula XIV, and wherein the resin component (B) and the compound component (C) are crosslinked. The crosslinked product is insoluble in alkali developer and is decomposable by the acid generated on irradiation to increase the solubility in alkali developer (claim 1). As specific examples of XXII, the formulas (a3), (a10), (a19), and (a20) are exemplified in columns 16, 17, and 19. Further, formulae (a22), (b), and (c) are also disclosed in the Examples (columns 19 and 87).

Aoai describes the advantages of his approach as follows:

> ... a positive resist composition suitable for the exposure using a light source of 220 nm or less, particularly an ArF excimer laser beam (193 nm) can be obtained.
> ... the positive resist composition ensures ... high transmissivity, high sensitivity, good resolution, sufficiently high resistance against dry etching, satisfactory adhesion to the substrate, and superior developability.... Accordingly, the positive resist composition can be effective used in the formation of a fine pattern necessary for producing a semiconductor device.

Column 95, lines 48-62.

However, Aoai fails to teach or suggest an oxygen-containing group substituted on a specific bridgehead position in relation to a specific (meth)acryloyl-containing group. Concerning formulae (1a-1) and (1a-2), specifically, Aoai is silent as to a combination of the specific unit $-CR^1R^2-$ and the oxygen-containing group. Regarding formulae (2a-1), (2d), and (2e), Aoai fails to teach or suggest any oxygen-containing group substituted on a bridgehead position. It goes without saying that Aoai fails to teach or suggest the compounds 1-hydroxy-3-(1-acryloyloxy-1,2-dimethylpropyl)adamantine (claim 15) and 2-hydroxy-6-acryloyloxy-tricyclo[5.2.1.$0^{2,6}$]decane (claim 16). Thus the present invention is not obtainable from the teaching of the Aoai reference.

Moreover, the present invention provides unexpected results. That is, regarding formulae (1a-1) and (1a-2), although Aoai discloses a (meth)acryloyl group and a carboxyl group both substituted on bridgehead positions,(for instance, (a22), (b) in the Aoai Examples, an oxygen atom of the (meth)acryloyl group is directly bonded to the adamantane ring. Such structures in Aoai make it difficult to eliminate the adamantane moiety by an acid generator and to hydrolyze the corresponding polymer by a developer, and as a result, sensitivity is not improved.

Regarding formulae (2a-1), (2d), and (2e), since no oxygen-containing group is substituted on a bridgehead position in Aoai, adhesion to a substrate would not be sufficiently improved.

In contrast, in accordance with the present invention, the oxygen-containing group substituted on a bridgehead position improves adhesion to the substrate, and a bulky ring or a bulky ring and the specific unit $-CR^1R^2-$ makes hydrolysis easy. Such results are not predictable from the teachings of the Aoai reference.

Conclusion

In accordance with the present invention, adhesion and resolution are improved and fine-line patterns are formed with high accuracy by the specified combination of specific rings and oxygen-containing groups. Such results could not have been predicted based upon the disclosures of the Aoai reference. Accordingly, the subject matter of claims 1, 2, 7-10, and 1-16 is both novel and unobvious, and the rejection of record is not sustainable.

Should there be any remaining isues to be resolved in the present application, the Examiner is respectfully requested to contact Richard Gallagher (Reg. No. 29,781) at (703) 205-8008 to conduct an interview in order to expedite the prosecution of the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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Attachment

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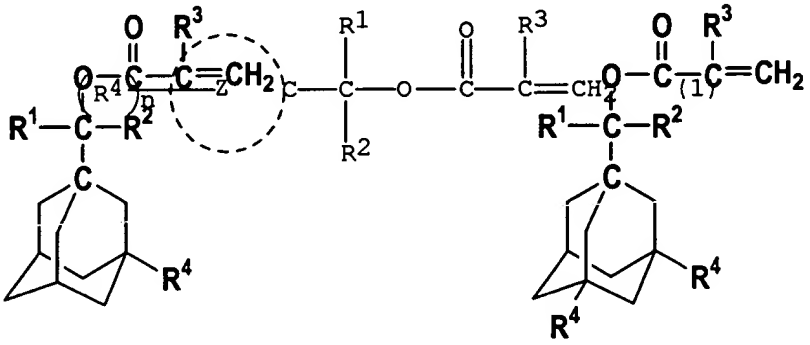
VERSION WITH MARKINGS TO SHOW CHANGES MADE:

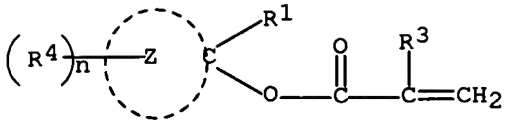
1. (four times amended) An acid-responsive compound represented by the following [formula (1)] formulae (1a-1) or (1a-2)



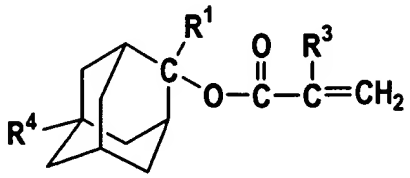
(1a-1) (1a-2)

wherein R^1 represents a hydrogen atom, an alkyl group or a cycloalkyl group; R^2 represents an alkyl group or a cycloalkyl group; R^3 represents a hydrogen atom or a methyl group; R^4 represents [a hydrogen atom, a halogen atom, an alkyl group,] an oxygen-containing group, [an amino group or an N-substituted amino group; n represents an integer of not less than 1; with proviso that all R^4s are not concurrently hydrogen atoms, and R^4 may be varied according to n; the Z ring represents an adamantane ring;] and in formula (1a-2), the two R^4 substituents may be the same as or different from one another; and R^1 and R^2 may, jointly and together with adjacent carbon atom, form an alicyclic hydrocarbon ring,

or by the following formula [(2)] (2a-1)



(2)



(2a-1)

wherein R^1 represents an alkyl group or a cycloalkyl group; R^3 represents a hydrogen atom or a methyl group; and R^4 represents [a hydrogen atom, a halogen atom, an alkyl group,] an oxygen-containing group, [an amino group or an N-substituted amino group; n represents an integer of not less than 1; with proviso that R^4 may be varied according to n; and Z represents an adamantane ring,]

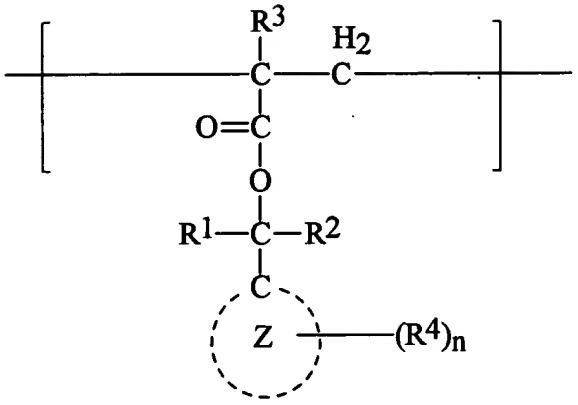
wherein [at least one of the R^4s in formula (1) and at least one of R^4s in formula (2) is an] the oxygen-containing group R^4 in formulae (1a-1), (1a-2), and (2a-1) is selected from the group consisting of [oxo groups,] hydroxyl groups, alkoxy groups, carboxyl groups, alkoxycarbonyl groups, cycloalkyloxycarbonyl groups, aryloxycarbonyl groups, aralkyloxycarbonyl groups, hydroxymethyl groups, carbamoyl groups, N-substituted carbamoyl groups, and nitro groups.

2. (twice amended) The acid-responsive compound according to Claim 1 having the formula (1a-1) or (1a-2) [(1)], wherein R^1 is a hydrogen atom and R^2 is a straight-chain or branched-chain C_{1-4}alkyl group.

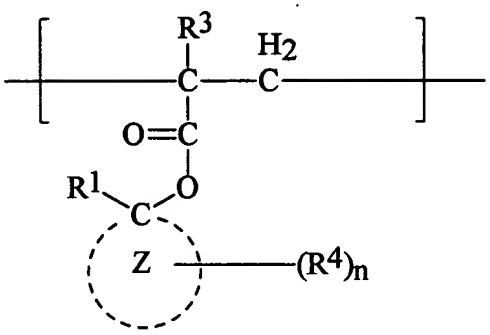
8. (twice amended) The acid-responsive compound according to Claim 1 [7], wherein R^1 in formulae (1a-1) and (1a-2) [(1a)] is a hydrogen atom or a straight-chain or branched-chain C_{1-4} alkyl group, and R^1 in formula (2a-1) [(2a)] is a straight-chain or branched-chain C_{1-4} alkyl group; and R^2 is a straight-chain or branched-chain C_{1-4} alkyl group[; R^3 is a hydrogen atom or a methyl group; at least one of R^4s is at least one oxygen-containing group selected from the group consisting of oxo groups, hydroxyl groups, alkoxy groups, carboxyl groups, alkoxycarbonyl groups, cycloalkyloxycarbonyl groups, aryloxycarbonyl groups, aralkyloxycarbonyl groups, hydroxymethyl groups, carbamoyl groups, N-substituted carbamoyl groups, and nitro groups].

10. (twice amended) A photoresist resin composition comprising

(i) a polymer having at least one unit [represented by the following formula (11) or (12):



(11)



(12)

wherein R^1, R^2, R^3, R^4, the Z rings, and n are as defined in Claim 1] corresponding to the acid-responsive compound of formula (1a-1), (1a-2), or (2a-1) as defined in Claim 1 or of formula (2d) or (2e) as defined in Claim 9 and

(ii) a photoactive acid precursor.

13. (twice amended) The photoresist resin composition according to Claim 10 [8], wherein the polymer is a copolymer.

14. (twice amended) A method of forming a pattern, which method comprises

subjecting a layer comprising the photoresist resin composition of Claim 10 [8] formed on a substrate to pattern exposure and

developing the exposed coating layer to form a pattern.